SMU Physics 1313 : Fall 2008

Exam 1

1. Complete the following statement: The term net force most accurately describes

(a) the mass of an object.
(b) the inertia of an object.
(c) the quantity that causes displacement.
(d) the quantity that keeps an object moving.
[e] the quantity that changes the velocity of an object.

2. When the net force that acts on a hockey puck is 10 N, the puck accelerates at a rate of 50 m/s^2. Determine the mass of the puck.

[a] 0.2 kg
(b) 1.0 kg
(c) 5 kg
(d) 10 kg
(e) 50 kg

Questions 3 and 4 pertain to the situation described below:

A physics student in a hot air balloon ascends vertically at constant speed. Consider the following four forces that arise in this situation:

F1 = the weight of the hot air balloon
F2 = the weight of the student
F3 = the force of the student pulling on the earth
F4 = the force of the hot air balloon pulling on the student

3. Which two forces form an action-reaction pair that obeys Newton's third law?

(a) F1 and F2
[b] F2 and F3
(c) F1 and F3
(d) F2 and F4
(e) F3 and F4

4. Which one of the following relationships concerning the forces or their magnitudes is true?

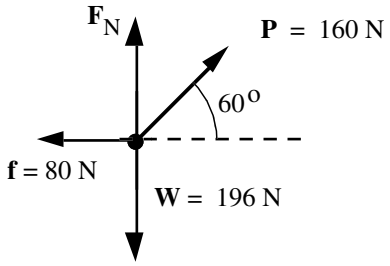
(a) F4 > F2
(b) F1 < F2
(c) F4 > F1
[d] F2 = F4
(e) F3 = F4

5. Two point masses m and M are separated by a distance d. If the separation d remains fixed and the masses are increased to the values 3m and 3M respectively, how does the gravitational force between them change?

(a) The force will be one-third as great.
(b) The force will be one-ninth as great.
(c) The force will be three times as great.
[d] The force will be nine times as great.
(e) It is impossible to determine without knowing the numerical values of m, M, and d.

6. Which statement best explains why the weight of an object of mass m is different on Mars than it is on the Earth?

(a) The mass of Mars is different from that of Earth.
[b] The masses and radii of Mars and Earth are not the same.
(c) The mass m is further from the Earth's center when it is on Mars.
(d) The constant G is different on Mars.
(e) The mass m will be different on Mars.



Questions 7 and 8 pertain to the figure above and the situation described below:

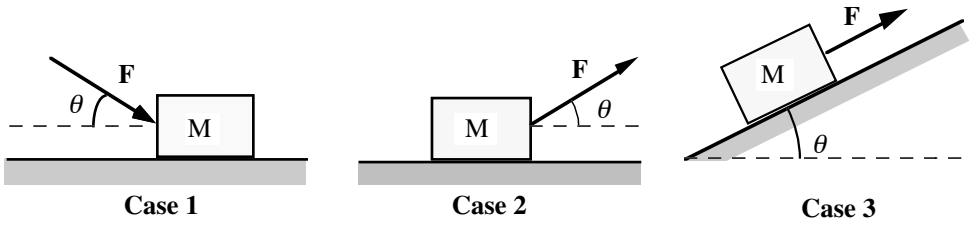
A force P pulls on a crate of mass m. The figure shows the magnitudes and directions of the forces that act on the crate in this situation. W represents the weight of the crate. F_N represents the normal force on the crate, and f represents a force pulling backwards on the crate.

7. Which statement best describes the motion of the crate?

(a) The crate must be at rest.
(b) The crate must be moving with constant velocity.
(c) The crate must be moving with constant acceleration.
[d] The crate may be either at rest or moving with constant velocity.
(e) The crate may be either at rest or moving with constant acceleration.

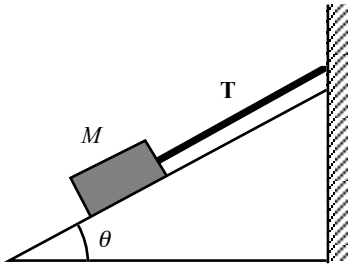
8. What is the magnitude of F_N, the normal force on the crate?

[a] 57 N
(b) 80 N
(c) 160 N
(d) 196 N
(e) 230 N



9. In which case will the magnitude of the normal force on the block in the above figure be equal to $(Mg + F\sin\theta)$?

[a] case 1 only
(b) case 2 only
(c) both cases 1 and 2
(d) both cases 2 and 3
(e) cases 1, 2, and 3



Questions 10 and 11 pertain to the figure above and the situation described below:
A block of mass M is held motionless on a frictionless inclined plane by means of a string attached to a vertical wall as shown in the drawing.

10. What is the magnitude of the tension T in the string?

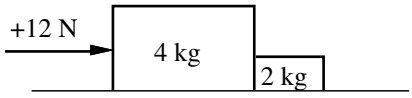
(a) Zero
(b) Mg
(c) $Mg\cos\theta$
[d] $Mg\sin\theta$
(e) $Mg\tan\theta$

11. If the string breaks, what is the magnitude of the acceleration of the block as it slides down the inclined plane?

(a) Zero
(b) g
(c) $g\cos\theta$
[d] $g\sin\theta$
(e) $g\tan\theta$

12. A 71 kg man stands on a bathroom scale in an elevator. What does the scale read if the elevator is ascending with an acceleration of $3.0\,\mathrm{m/s^2}$?

(a) 140 N
(b) 480 N
(c) 690 N
(d) 830 N
[e] 910 N



13. As shown in the above figure, a 4 kg block and a 2 kg block move on a horizontal frictionless surface. The blocks are accelerated by a +12 N force that pushes the larger block against the smaller one. Determine the force that the 2 kg block exerts on the 4 kg block.

(a) −12 N
[b] −4 N
(c) 0 N
(d) +4 N
(e) +8 N

14. The second hand on a watch has a length of 4.50×10^{-3} m and makes one revolution in 60.00 s. What is the speed of the end of the second hand as it moves in uniform circular motion?

(a) $9.42\times10^{-4}\,\mathrm{m/s}$
(b) $2.67\times10^{-3}\,\mathrm{m/s}$
(c) $5.34\times10^{-3}\,\mathrm{m/s}$
[d] $4.71\times10^{-4}\,\mathrm{m/s}$
(e) $2.36\times10^{-5}\,\mathrm{m/s}$

15. A rock is whirled on the end of a string in a horizontal circle of radius R with a constant period T. If the radius of the circle is reduced to R/2, while the period remains T, what happens to the centripetal acceleration of the rock?

(a) It remains the same.
(b) It increases by a factor of 2.
(c) It increases by a factor of 4.
[d] It decreases by a factor of 2.
(e) It decreases by a factor of 4.

16. A satellite is placed in a circular orbit to observe the surface of Mars from an altitude of 144 km. The equatorial radius of Mars is 3397 km. If the speed of the satellite is 3480 m/s, what is the magnitude of the centripetal acceleration of the satellite?

(a) 2.17 m/s^2
(b) 2.60 m/s^2
(c) 2.99 m/s^2
[d] 3.42 m/s^2
(e) 4.05 m/s^2

17. A certain string just breaks when it is under 400 N of tension. A boy uses this string to whirl a 10 kg stone in a horizontal circle of radius 10 m. The boy continuously increases the speed of the stone. At approximately what speed will the string break?

(a) 10 m/s
[b] 20 m/s
(c) 80 m/s
(d) 100 m/s
(e) 400 m/s

18. Consider a satellite in a circular orbit around the Earth. If it were at an altitude (height above earths surface) equal to twice the radius of the Earth, $2R_e$, how would its speed v be related to the Earth's radius $2R_e$, and the magnitude g of the acceleration due to gravity on the Earth's surface?

(a) $v^2 = gR_e/9$
(b) $v^2 = 2gR_e$
[c] $v^2 = gR_e/3$
(d) $v^2 = gR_e/4$
(e) $v^2 = gR_e/2$

19. The orbital radius about the Sun of Saturn is about 10 times that of Earth. Complete the following statement: The period of Saturn is about

(a) 10 yr.
[b] 30 yr.
(c) 40 yr.
(d) 90 yr.
(e) 160 yr.

20. The mass and radius of the moon are $M = 7.4 \times 10^{22}$ kg and $r = 1.7 \times 10^{6}$ m, respectively. What is the weight of a 1.0 kg object on the surface of the moon?

(a) 1.0 N
[b] 1.7 N
(c) 3.7 N
(d) 8.8 N
(e) 9.8 N